Regional Water Quality NEWSLETTER

DATE: Report for June 12, 2006
Samples Collected on June 15, 2006
From the Phoenix, Tempe, Peoria, CAP, SRP – ASU Regional Water Quality Partnership

http://enpub.fulton.asu.edu/pwest/tasteandodor.htm

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SUMMARY: EVALUATION AND RECOMMENDATIONS

1. MIB concentrations are low throughout the system and WTPs. MIB is present at 5 to 15 ng/L in the Verde River system. However, currently very little Verde River water is entering the SRP canal system.
2. Geosmin concentrations are starting to increase. Geosmin concentrations at Val Vista, Union Hills, Tempe North, and Chandler are in the 2 to 5 ng/L range.
3. Geosmin concentrations went from < 5 ng/L in May 2006 to **90 ng/L** in the epilimnion (upper 10 m of the water column) in Saguaro Lake.
4. It appears we are just beginning the 2006 Taste and Odor season.
5. Several WTPs are adding PAC currently in an attempt to improve removal of DBP precursors, prior to chlorination. While this may appear to be a good idea, it would be more beneficial to increase alum dosages (this would also be cheaper than feeding PAC). More DOC will be removed by increasing alum feed by 5 to 15 mg/L than adding 15 mg/L of PAC.
6. A summary of arsenic occurrence is presented at the end of this Newsletter for the past 1 year in the regional system of waterways.

Table 1 Summary of WTP Operations

	Union Hills	24th Street WTP	N.Tempe J.G. Martinez	Deer Valley	Greenway WTP	Val Vista	South Tempe	Chandler WTP
Location	**CAP**	**Arizona Canal System**				**South Canal System**		
PAC Type and Dose		Norit 20B 15ppm	Off (but will add 20 ppm)		No	Norit 20B 15ppm		No
Copper Sulfate		No	no		No	0.25ppm		No
PreOxidation		No	No		O3=2 ppm	No		No
Alum Dose Alkalinity pH		50ppm 136ppm 6.8	27ppm[3] 143ppm 7.5		15ppm 151ppm 7.6	60 ppm 138ppm 6.8		26ppm 144ppm 7.9
WTP Comments	No data provided	PAC added for DBP control		No data provided		Trying to minimize DBPs with PAC	No data provided	
Raw water DOC % DOC removal[2]	2%	38%	21%	51%	15%	41%=49% WTP reports 47% TOC removal	30%	
Process Recommendations	Start planning for PAC addition in July 2006 this year for T&O control							

[1] **Ferric chloride instead of alum**
[2] Calculated based upon influent and filtered water DOC
[3] Also adding 4 ppm Clariflox C358 floc aid

MONITORING RESULTS

Table 2 - Water Treatment Plants – June 12, 2006

Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
24th Street WTP Inlet	<2.0	2.2	<2.0
24th Street WTP Treated	<2.0	<2.0	<2.0
Deer Valley Inlet	<2.0	2.4	<2.0
Deer Valley WTP Treated	<2.0	<2.0	<2.0
Val Vista Inlet	<2.0	3.4	4.3
Val Vista WTP Treated –East	<2.0	<2.0	<2.0
Val Vista WTP Treated -West	<2.0	<2.0	<2.0
Union Hills Inlet	<2.0	7.1	2.8
Union Hills Treated	<2.0	8.2	<2.0
Tempe North Inlet	<2.0	3.1	4.4
Tempe North Plant Treated	<2.0	<2.0	<2.0
Tempe South WTP	<2.0	<2.0	<2.0
Tempe South Plant Treated	<2.0	<2.0	<2.0
Chandler WTP Inlet	2.5	2.6	6.4
Chandler WTP Treated	<2.0	<2.0	<2.0
Greenway WTP Inlet	<2.0	2.9	<2.0
Greenway WTP Treated	<2.0	<2.0	2.6

Table 3 - Canal Sampling – June 12, 2006

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
CAP	Waddell Canal	**<2.0**	**5.8**	**4.0**
	Union Hills Inlet	**<2.0**	**7.1**	**2.8**
	CAP Canal at Cross-connect	**<2.0**	**8.9**	**5.6**
AZ Canal	Salt River @ Blue Pt Bridge	**<2.0**	**4.2**	**5.1**
	Verde River @ Beeline	**13.8**	**4.7**	**11.3**
	AZ Canal above CAP Cross-connect	**<2.0**	**7.1**	**5.4**
	AZ Canal below CAP Cross-connect	**<2.0**	**3.3**	**4.3**
	AZ Canal at Highway 87	**<2.0**	**3.9**	**8.2**
	AZ Canal at Pima Rd.	**<2.0**	**3.2**	**<2.0**
	AZ Canal at 56th St.	**<2.0**	**4.0**	**3.6**
	AZ Canal - Inlet to 24th Street WTP	**<2.0**	**2.2**	**<2.0**
	AZ Canal - Central Avenue	**<2.0**	**2.1**	**<2.0**
	AZ Canal - Inlet to Deer Valley WTP	**<2.0**	**<2.0**	**<2.0**
	AZ Canal - Inlet to Greenway WTP	**<2.0**	**2.9**	**<2.0**
South and Tempe Canals	South Canal below CAP Cross-connect	**<2.0**	**2.5**	**5.0**
	South Canal at Val Vista WTP	**<2.0**	**3.4**	**4.3**
	Head of the Tempe Canal	**2.2**	**4.1**	**4.4**
	Tempe Canal - Inlet to Tempe's South Plant	**<2.0**	**<2.0**	**<2.0**
	Chandler WTP – Inlet	**2.5**	**2.6**	**6.4**

Table 4 - Reservoir Samples – June 13, 2006

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant	Eplimnion	**<2.0**	**<2.0**	**<2.0**
Lake Pleasant	Hypolimnion	**2.6**	**<2.0**	**<2.0**
Verde River @ Beeline		**13.8**	**4.7**	**11.3**
Bartlett Reservoir	Epilimnion	**9.8**	**<2.0**	**<2.0**
Bartlett Reservoir	Epi-near dock	**14.5**	**<2.0**	**<2.0**
Bartlett Reservoir	Hypolimnion	**<2.0**	**<2.0**	**<2.0**
Salt River @ BluePt Bridge		**<2.0**	**4.2**	**5.1**
Saguaro Lake	Epilimnion	**<2.0**	**82.5**	**3.6**
Saguaro Lake	Epi - Duplicate	**<2.0**	**96.4**	**3.4**
Saguaro Lake	Epi-near doc	**<2.0**	**88.9**	**2.7**
Saguaro Lake	Hypolimnion	**<2.0**	**5.3**	**<2.0**
Verde River at Tangle		**4.9**	**2.9**	**3.1**
Havasu		**<2.0**	**2.5**	**<2.0**

Table 5 - Water Treatment Plants – June 12, 2006

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA	Percentage DOC Removal
24th Street WTP Inlet	4.73	0.0968	2.0	
24th Street WTP Treated	2.95	0.0376	1.3	38%
Deer Valley Inlet	4.61	0.0933	2.0	
Deer Valley WTP Treated	2.28	0.0317	1.4	51%
Val Vista Inlet	5.08	0.1060	2.1	
Val Vista WTP Treated –East	3.01	0.0340	1.1	41%
Val Vista WTP Treated -West	2.60	0.0270	1.0	49%
Union Hills Inlet	2.57	0.0212	0.8	
Union Hills Treated	2.52	0.0195	0.8	2%
Tempe North Inlet	4.64	0.0959	2.1	
Tempe North Plant Treated	3.67	0.0532	1.4	21%
Tempe South WTP	4.95	0.1035	2.1	
Tempe South Plant Treated	3.49	0.0510	1.5	30%
Chandler WTP Inlet				
Chandler WTP Treated				
Greenway WTP Inlet	4.63	0.0913	2.0	
Greenway WTP Treated	3.93	0.0317	0.8	15%

Table 6 - Canal Sampling – June 12, 2006

System	Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA
CAP	Waddell Canal	3.18	0.0375	1.2
	Union Hills Inlet	2.57	0.0212	0.8
	CAP Canal at Cross-connect	2.99	0.0361	1.2
AZ Canal	Salt River @ Blue Pt Bridge	4.86	0.1080	2.2
	Verde River @ Beeline	1.86	0.0345	1.9
	AZ Canal above CAP Cross-connect	2.69	0.0367	1.4
	AZ Canal below CAP Cross-connect	4.25	0.0848	2.0
	AZ Canal at Highway 87	4.50	0.0921	2.0
	AZ Canal at Pima Rd.	7.65	0.0955	1.2
	AZ Canal at 56th St.	4.65	0.0955	2.1
	AZ Canal - Inlet to 24th Street WTP	4.73	0.0933	2.0
	AZ Canal - Central Avenue	4.63	0.0954	2.1
	AZ Canal - Inlet to Deer Valley WTP	4.61	0.0933	2.0
	AZ Canal - Inlet to Greenway WTP	4.63	0.0913	2.0
South and Tempe Canals	South Canal below CAP Cross-connect	4.92	0.1040	2.1
	South Canal at Val Vista WTP	5.08	0.1060	2.1
	Head of the Tempe Canal	4.51	0.0947	2.1
	Tempe Canal - Inlet to Tempe's South Plant	4.95	0.1035	2.1
	Chandler WTP – Inlet			

Table 7 - Reservoir Samples – June 12, 2006

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA
Lake Pleasant	Eplimnion	3.63	0.0572	1.6
Lake Pleasant	Hypolimnion	4.11	0.0540	1.3
Verde River @ Beeline		1.86	0.0345	1.9
Bartlett Reservoir	Epilimnion	2.86	0.0429	1.5
Bartlett Reservoir	Hypolimnion	2.80	0.0566	2.0
Salt River @ BluePt Bridge		4.86	0.1080	2.2
Saguaro Lake	Epilimnion	5.28	0.1149	2.2
Saguaro Lake	Epi - Duplicate	5.63	0.1112	2.0
Saguaro Lake	Hypolimnion	5.45	0.1092	2.0
Verde River at Tangle		1.27	0.0245	1.9
Havasu		2.85	0.0339	1.2

Table 5 - SRP/CAP OPERATIONS

Values in cfs, for June 12, 2006

System	SRP Diversions	CAP
Arizona Canal	748	122
South Canal	894	0
Pumping	162	0
Total	1804	122

SRP is releasing water from both Verde and Salt River Systems. Salt River release from Saguaro Lake: 1546 cfs; Verde River release from Bartlett Lake: 125 cfs.

Central Arizona Project

Operations and Maintenance Update

6/11/2006

WADDELL RELEASE SCHEDULE

		% Flow	Date	Time
Current Waddell Releases	0 cfs	0%	06/12/06	12:00
Current Pass-Thru Flow	2400 cfs	100%	06/12/06	12:00
New Waddell Releases	400 cfs	14%	06/13/06	00:00
New Pass-Thru Flow	2400 cfs	86%	06/13/06	00:00
New Waddell Releases	cfs			
New Pass-Thru Flow	cfs			
New Waddell Releases				
New Pass-Thru Flow				

SPECIAL NOTES / AQUEDUCT ACTIVITIES

06/10/2006, Maintenance crews will be scraping the canal from Tatum Blvd. Downstream to kill caddis fly larvae that are growing on the sides of the canal. They will be working up and downstream of this area for several days. This may cause an increase of turbidity from the sediment on the canal slopes.

6/13/2006, Waddell releases will start at 00:01 until deliveries decrease lower than what can be supplied from the west plants.

06/19/2006, Waddell canal scraping will start to remove algae growing on the sides of the canal before high flow releases from the lake start on July 5th. This may cause an increase of turbidity.

Bench-scale tests on: Alum coagulation and PAC adsorption for DOC removal

This section is duplicated from last year (2005) because of continued interest in adding PAC to control DBP formation.

PURPOSE OF TESTS

To evaluate the performance of alum coagulation and PAC adsorption for THM precursor (DOC) removal in the 2 kind of Reservoir waters (Roosevelt and Saguaro) using jar tests.

RECOMMENDATION

The data suggests that adding PAC provides a small benefit for DOC removal. It is recommended to increase alum dosages rather than adding PAC, as increasing alum dosages leads to more significant improvements in DOC removal than PAC addition.

METHODOLOGY

Raw water(see Table 1), which was collected from the Saguaro and Roosevelt Lake, was used to alum coagulation and PAC adsorption test.

Table 1. Characteristics of water quality in Saguaro and Roosevelt Lake (Data from City of Phoenix)

Lake	Roosevelt	Saguaro
Sample Date	4/9/2005	4/12/2005
Sample Depth	surface	20m
Turbidity (NTU)	90	2.4
pH	8.09	7.90
Alkalinity (mg/L)	94	112
UV254	0.188	0.157
TOC (mg/L)	6.68	6.34
Chloride (mg/L)	89	314
Bromide (mg/L)	0.039	0.141
Nitrate (mg/L)	0.821	0.328
Sulfate (mg/L)	30	56
Hardness (mg/L)	120	168
Calcium (mg/L)	35	43
Magnesium (mg/L)	8	14

Alum Coagulation. The device used for the test was a jar test apparatus. In the jars, 2 L of raw water from Saguaro Lake or Roosevelt Lake was filled to room temperature. The alum (coagulant) and polymer (coagulant aid) was added to each 2 L jar containing the sample water with rapid mixing at 150 rpm. After 1 min of rapid mix, 15 min of slow mixing at 75, 50, and 30 rpm (each for 5 min) was provided, followed by at 40 min of settling. At the end of the settling period, water samples were taken from the supernatants and analyzed for turbidity, pH, DOC and UV_{254}. The samples were filtered with GF/F filter paper for analysis of DOC and UV_{254}. The rest of samples were put into the 40 mL vials with 6 mg/L of chlorine. These bottles were then put on the table during 10 min. After reaction with the filtered water and chlorine, samples were measured residual chlorine. The optimum coagulant dose was determined after measured the turbidity and DOC.

PAC Adsorption. PAC was added each 2 L jar containing the sample water from a 1,000 mg/L slurry stock solution to produce concentration of 0, 5, and 15 mg/L, respectively. The water samples were collected after mixed at 150 rpm for 120 minutes. PAC was removed from the samples prior to analysis of DOC and UV_{254} using GF/F filter paper. The chlorination tests were performed in the same fashion as described above alum coagulation test.

PAC Adsorption and Alum Coagulation. PAC adsorption tests were performed in the same fashion as described above section 2, followed by coagulation in the optimum alum dosage. Turbidity was measured with a Turbidimeter (HACH). pH was measured with a pH meter (Beckman Φ250). The each of filtered waters was measured the DOC using TOC analyzer (Shimadzu, TOC-5050A). UVA_{254} was measured with a UV/VIS Spectrophotometer (Shimadzu, Multispec-1501). The residual chlorine was measured with DR2000 (HACH) instrument.

RESULTS

Fig. 1 and 2 show variation in Turbidity, DOC, pH, and residual chlorine according to alum dosage in Saguaro and Roosevelt Lake water. Turbidity, DOC, and pH was decreased when the alum dosage was increased. However, residual chlorine was increased because the DOC in the water was removed by alum. The optimum alum dosage in the raw water of Saguaro and Roosevelt Lake was determined 60 and 80 mg/L, respectively.

Fig. 3 and 4 show the concentration of DOC and residual chlorine according to PAC dosage in the Saguaro and Roosevelt Lake. Increasing PAC dose lead to slightly improved DOC removal. Norit 20B had better removal for DOC than Norit HDB.

DOC removal in the Roosevelt Lake was slightly better than Saguaro Lake. When the PAC was added with alum, the DOC removal efficiency was better than alum was added alone. The residual chlorine was increased according to PAC dosage.

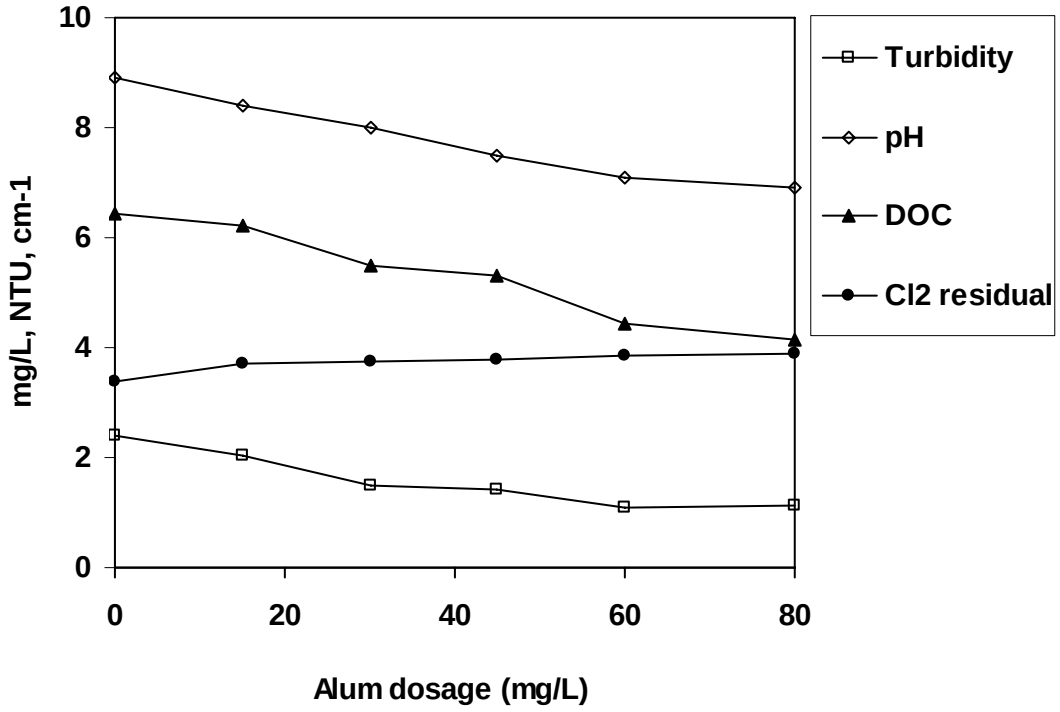


Fig. 1. Variation in Turbidity, pH, DOC, and residual chlorine according to alum dosage (Saguaro Lake)

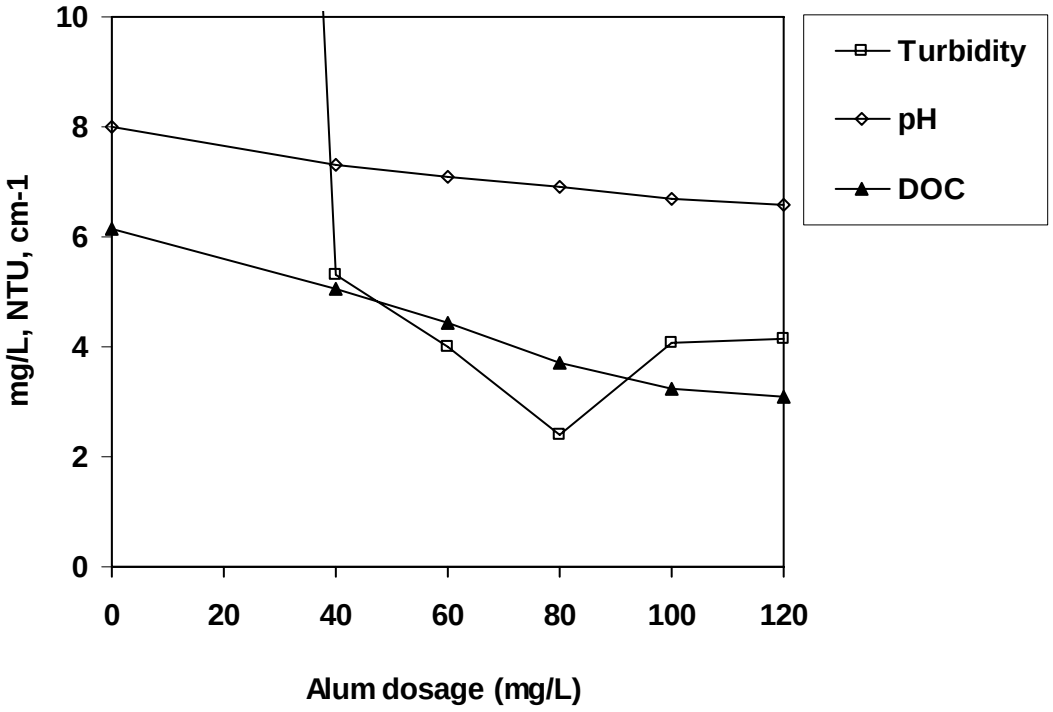


Fig. 2. Variation in Turbidity, pH, DOC, and residual chlorine according to alum dosage (Roosevelt Lake)

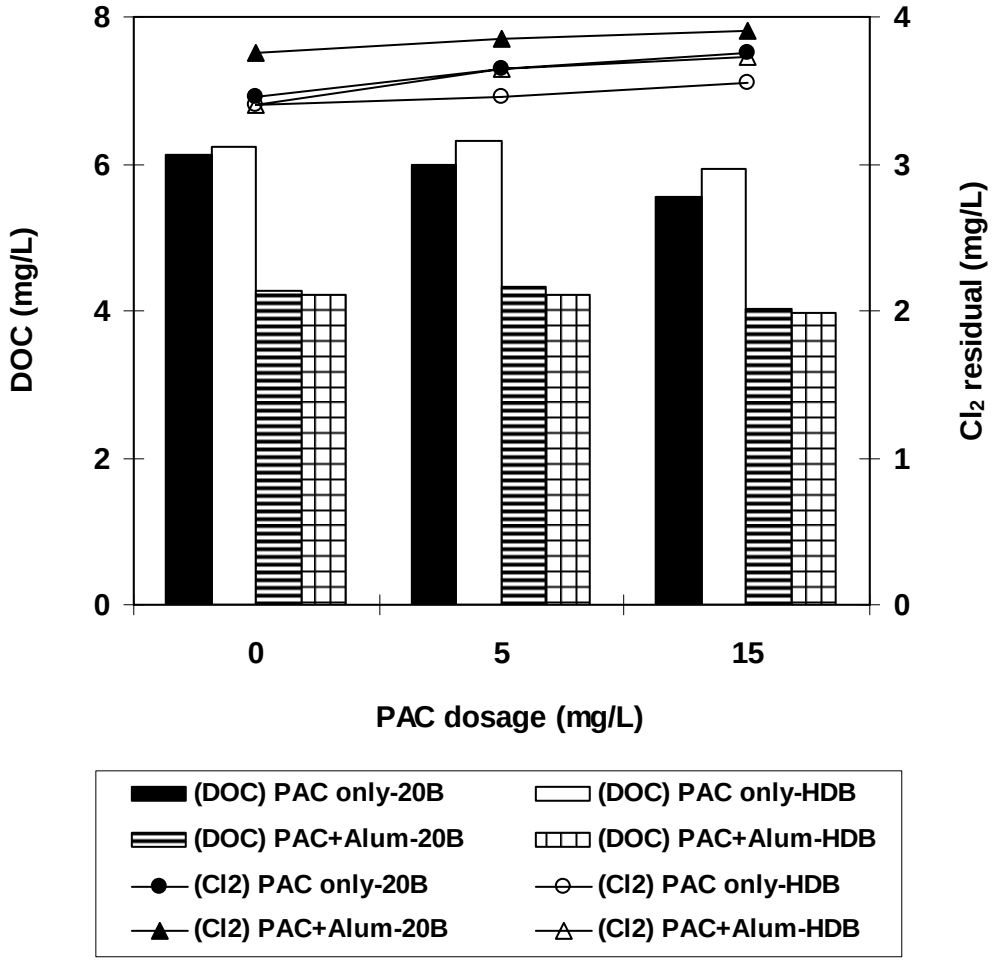


Fig. 3. Concentration of DOC and residual chlorine according to PAC dosage (Saguaro Lake)

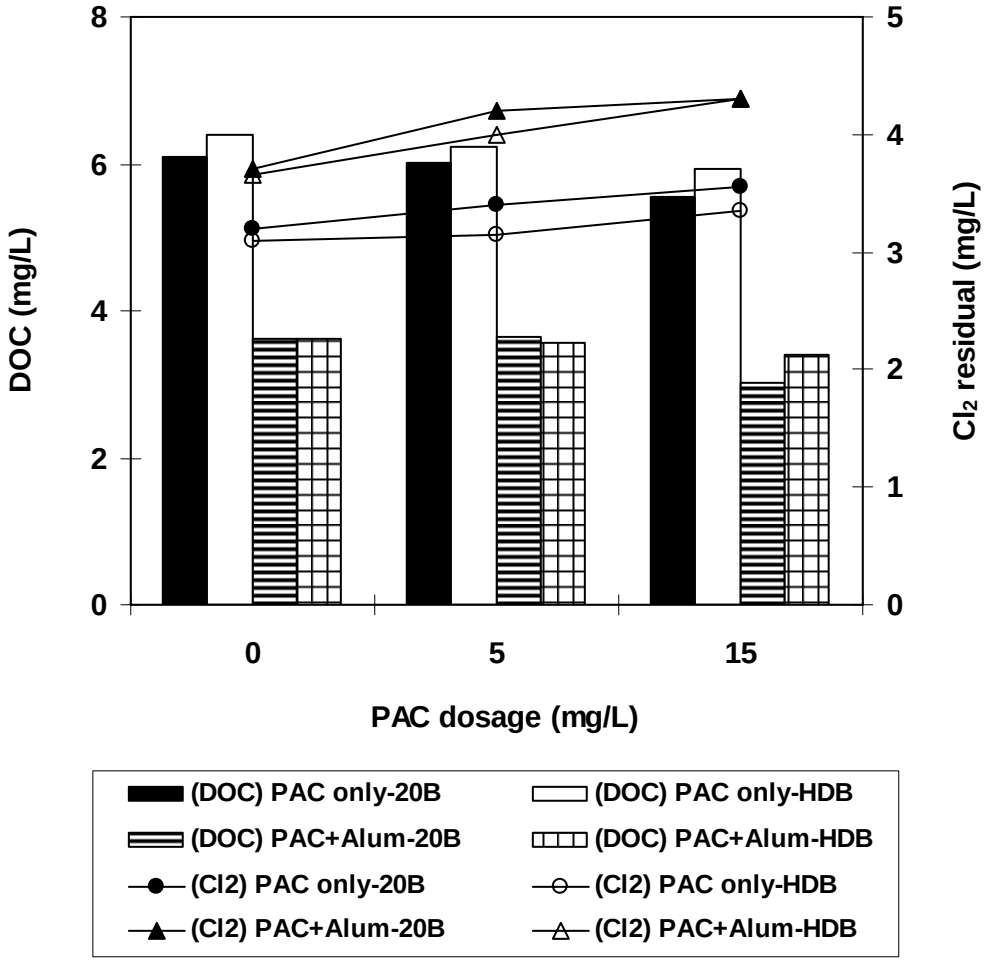


Fig. 4. Concentration of DOC and residual chlorine according to PAC dosage (Roosevelt Lake)

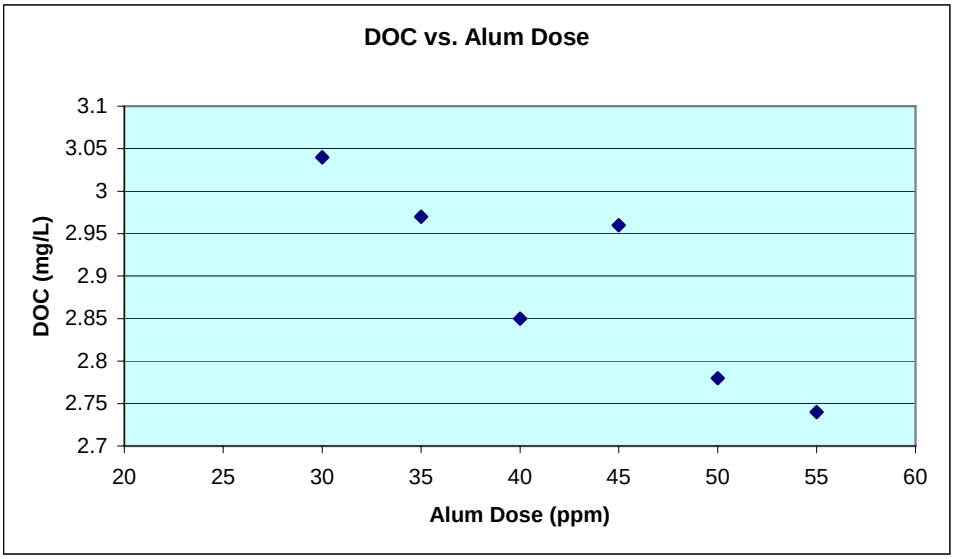
Jar tests by City of Phoenix (2005)

To follow-up from Jar tests conducted for Item III above, Yu-chu Hsu (Chemist II, City of Phoenix, 24th street WTP) conducted jar tests at reduced pH and higher alum dosages than currently in use (~ 30 to 40 mg/L alum). Below, the results of a jar test performed on 5/13/05 with alum dosages from 30 to 55 ppm. The initial UVA was 0.124, but initial DOC was not measured. The results showed that increasing the alum dose generally decreases the settled water turbidity, UV254, and DOC. Jar #4 seemed to be an outlier, and did not follow the overall decreasing trend for the analytes of interest. The trend did flatten somewhat toward the high end of the alum dosages, but not dramatically.

Jar tests 5/13/05
24th St. Lab

Raw Turbidity	21 NTU	**Rapid Mix:**	60 sec at 100 rpm
Raw Temp.	66 deg. F	**Slow Mix:**	30 min at 20 rpm
Raw pH	8.33	**Settling:**	60 min at 0 rpm
Raw Alkalinity	120 ppm	Sample taken from sample port	

Jar Number	**1**	**2**	**3**	**4**	**5**	**6**
Alum Dose (ppm)	30	35	40	45	50	55
C-308P Dose (ppm)	2.5	2.5	2.5	2.5	2.5	2.5
Acid Dose (ppm)	30	28	26	24	22	20
Turbidity	0.77	0.62	0.57	0.63	0.52	0.39
pH	6.74	6.7	6.92	6.92	6.99	6.99
UV254	0.0606	0.059	0.0552	0.0577	0.0532	0.0516
DOC	3.04	2.97	2.85	2.96	2.78	2.74



Arsenic Update

The graphic below summarizes arsenic concentrations in terminal reservoirs and WTP inlets on the three different canal systems over the past year.